REMARKS

The Examiner rejected claims 1 and 27 under 35 U.S.C. 102(b) as being anticipated by Xu et al. ("Mobile IP Based Micro Mobility Management Protocol in The Third Generation Wireless Network," Internet Draft, pp. 1-16, November 2000). This rejection is respectfully disagreed with, and is traversed below.

One issue at hand concerns the characterization of various wireless terms and technologies including "WLAN," "cellular network," "CDMA2000" and "Mobile IP."

As an initial observation, the Applicants would like to point out that "CDMA2000," "UMTS," "Mobile IP," "IEEE 802.11" ("802.11"), "HiperLAN" and "Bluetooth" refer to established communication protocols and/or standards. In particular, "CDMA2000" indicates a family of standards established by the 3rd Generation Partnership Project 2 (3GPP2). See e.g. "Introduction to cdma2000 Standards for Spread Spectrum Systems," 3GPP2 C.S0001-C Version 1.0, May 28, 2002. "802.11" indicates a family of standards established by the Institute of Electrical and Electronics Engineers (IEEE). See e.g. "Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications," ANSI/IEEE Std 802.11, 1999 Edition (R2003). Similar definitions, as based on underlying documents officially published by the respective standards-setting body, hold for the other communication protocols identified above, including Mobile IP.

In discussing wireless systems, one often refers to "technologies," "systems" or "networks," such as "CDMA2000 technology," "a CDMA2000 system" or "a CDMA2000 network." Such references indicate that the technology, system or network being discussed employs that particular standard or a standard from that body of standards.

The Applicants disagree with the Examiner's repeated assertions, as made in the previous Office Action of October 24, 2005 and as impliedly made in the Final Office Action of March 21, 2006, that CDMA2000 is a WLAN technology.

It is well established that "[a] patentee can choose his own terms and use them as he wishes so long as he remains consistent in their use and makes their meaning reasonably clear." Ellipse Corp. v. Ford Motor Co., 452 F.2d 163, 167, 171 USPQ 513, 515 (7th Cir. 1971), cert. denied, 406 U.S. 948, 173 USPQ 705 (1972). "A patentee may define his own terms, regardless of common or technical meaning, and fairness to the patentee requires the court to accept his definition of words, phrases, and terms." International Cork Co. v. New Process Cork Co., 6 F.2d 420, 422 (2d Cir. 1925).

Page 1 of the Specification of the instant application states:

> **Cellular wireless technologies, such as cdma2000 and Universal Mobile Telecommunication System (UMTS)**, are expected to provide high speed wireless Internet connectivity to mobile users over a wide coverage area. At the same time, **WLAN technologies, such as IEEE 802.11 and European HiperLAN**, are becoming increasingly popular, as they provide a low cost and high speed wireless access solution for localized "hot spots". (emphasis added)

The Specification of the instant application clearly sets forth two distinct technologies: "cellular wireless technologies" and "WLAN technologies." One notable difference between the two technologies, as specified, is that cellular wireless technologies have a "wide coverage area" while WLAN technologies are for "localized hot spots." The Specification also indicates example standards and bodies of standards that each category of technologies encompasses. Cellular wireless technologies comprise CDMA2000 and UMTS while WLAN technologies comprise IEEE 802.11 and European HiperLAN. As characterized and described in the Specification of the instant application, clearly CDMA2000 is **not** a WLAN technology.

In the Response to Arguments section on pages 13-14 of the Final Office Action dated March 21, 2006, the Examiner states:

> Mobile IP is the most relevant WLAN technology and it is disclosed in the instant application. Mobile IP must have all the functionalities or elements of a

> mobile host (MH), a home agent (HA), a foreign agent (FA) and a corresponding host (CH). There is no doubt that Su's system, as clearly pointed out in the Office Action, is the WLAN because all of the above functionalities or element are disclosed and incorporated in the Su's system (*see Fig. 1 and pages 3-4 of Su reference*). Thus, Examiner asserts the interpretation of Xu reference is exact to that claimed by the Applicants of the instant application.

As an initial matter, the Applicants presume that the repeated references to "Su" are meant to indicate the "Xu" reference as identified in the Final Office Action, the Office Action of October 24, 2005 and elsewhere.

The Applicants dispute the Examiner's characterization of Mobile IP as "the most relevant WLAN technology" and the definition the Examiner attributes to Mobile IP based on constituent elements of a MH, a HA, a FA and a CH. In addition, the Applicants contest the assertion that the system discussed in Xu et al. relates to WLAN technology. Moreover the Applicants refute the assertion that Xu et al. anticipates the instant application.

Page 2 of the Specification of the instant application states:

> The Internet Engineering Task Force (IETF) has developed a Mobile IP protocol to enable IP-layer handoffs during an ongoing Internet session. To minimize disruption to the mobile node's Internet connectivity during such handoffs, protocols such as Fast Handoff and Context Transfer are also under development. While these protocols provide the core framework for seamless inter-technology handoffs, additional effort is required to apply them to specific environments. Further, these protocols assume the existence of a "trusting" relationship between the source (e.g., WLAN) and destination (e.g., cdma2000) access networks, which is not always the case.
> ...
> The method advantageously requires no significant modification to existing cellular network protocol architectures. Further, the method is compatible with IP-layer handoff techniques such as low-latency Mobile IPv4 and fast Mobile IPv6.

As an initial matter, although Mobile IP is disclosed in the instant application, it is clearly not "the most relevant WLAN technology" as the Examiner asserts. The adaptation of the invention

to Mobile IP is discussed in the Specification of the instant application but by no means is this adaptation characterized as "the most relevant WLAN technology." If the Examiner persists in this mischaracterization, the Applicants respectfully request that the Examiner provide supporting citations and reasoning to back up this allegation.

As described in the Specification of the instant application, and as understood in the art, Mobile IP is a protocol developed by the IETF. See e.g. "Low Latency Handoff in Mobile IPv4," Malki et al., Internet Draft, pages 1-65, May 2001; "Mobility Support in IPv6," Johnson et al., Internet Draft, pages 1-149, October 2002; "IP Mobility Support," Perkins, Request For Comments (RFC 2002), pages 1-79, October 1996. Although Mobile IP may involve elements such as a MH, a HA, a FA and a CH, since Mobile IP is **a protocol** it cannot be defined exclusively by the presence of those four elements. To define Mobile IP in such a manner, as a system "hav[ing] all the functionalities or elements of a mobile host (MH), a home agent (HA), a foreign agent (FA) and a corresponding host (CH)," as the Examiner does, is erroneous.

The Examiner compounds this inaccurate definition by applying it to Xu et al. and stating: "There is no doubt that Su's system, as clearly pointed out in the Office Action, is the WLAN because all of the above functionalities or element are disclosed and incorporated in the Su's system (*see Fig. 1 and pages 3-4 of Su reference*)." Here the Examiner is asserting that the system described by Xu et al. encompasses a WLAN because it contains all four of the elements in the Examiner's definition of Mobile IP.

First, in this assertion the Examiner implicitly equates Mobile IP to a WLAN by incorporating the Examiner's alleged definition for Mobile IP into a definition for WLAN. Although Mobile IP can be employed with respect to WLAN systems, the two are distinctly different entities. As noted above, Mobile IP is a protocol while WLAN refers to a type of network, as specified in the Specification of the instant application. To equate Mobile IP with a WLAN is fallacious. Second, as explained immediately above, the Examiner's four-element definition for Mobile IP is itself incorrect. Thus, since the Examiner implicitly equates Mobile IP to a WLAN and employs an erroneous definition of Mobile IP, the Examiner's alleged application of WLAN to Xu et al. is

also incorrect.

The appropriate definition of WLAN to be used in interpreting Xu et al. and comparing the disclosure of Xu et al. with that of the instant application is the definition as provided by the instant application on page 1 of the Specification:

> WLAN technologies, such as IEEE 802.11 and European HiperLAN, are becoming increasingly popular, as they provide a low cost and high speed wireless access solution for localized "hot spots".

In the Abstract and Introduction sections, Xu et al. state:

> This document defines extensions to the Mobile IP protocol to allow mobility management for the interface between a radio network and a packet data network **in the third generation cdma2000 network**. (emphasis added)

Xu et al. exclusively discuss Mobile IP as it relates to a CDMA2000 network. As enumerated in the Specification of the instant application, CDMA2000 is a cellular wireless technology and **not** a WLAN technology. Hence, the Examiner's assertion that the system discussed in Xu et al. relates to WLAN technology is incorrect.

At 4.1, Xu et al. state:

> In a cdma2000 network, the mobile node **initiates a connection** by sending a call setup indication to the RNN across the radio network. When this indication is received by a RNN, a Registration Request will be sent from the RNN to the PDSN to setup a new RP session. (emphasis added)

Here, Xu et al. are discussing the process by which a "mobile node initiates a connection." Xu et al. are **not** discussing handoffs in this section. The instant application relates to handoffs. Hence, the Examiner's alleged application of section 4.1 of Xu et al. to the instant application, as made on page 14 in the Response to Remarks section of the Final Office Action dated March 21, 2006, is incorrect.

Should the Examiner remain unconvinced that the correct definition of WLAN to apply to Xu et al. is the one put forth by the Specification of the instant application, in the alternative the Applicants wish to note that Pahlavan et al., the document the Examiner introduced in the Notice of References Cited appended to the Final Office Action, supports the Applicants' position that CDMA2000 is not synonymous with WLAN technology.

As the Abstract states, Pahlavan et al. "presents an overview of issues related to handoff with particular emphasis on hybrid mobile data networks." Of particular note, Pahlavan et al. compare handoff procedures among three architectures or technologies: IEEE 802.11 WLANs, General Packet Radio Service (GPRS) networks and Cellular Digital Packet Data (CDPD) networks. <u>See e.g.</u> Pahlavan et al., Table 1 on p. 40. In describing these terms on page 35 of the document, Pahlavan et al. characterize IEEE 802.11 WLANs as "small-coverage high-bandwidth data networks." GPRS is characterized as "low bandwidth." CDPD is characterized as having "low-speed wide-area-coverage." CDMA2000 does not include small-coverage high-bandwidth data networks, as Pahlavan et al. have characterized IEEE 802.11 WLANs. Rather, CDMA2000 corresponds with a (relatively) low-speed wide-area-coverage network. Although not explicitly stated, it is clear that a CDMA2000 network would fall under the CDPD technology. Since the CDPD technology is distinct from the IEEE 802.11 WLAN technology, CDMA2000 does not fall under the WLAN technology category.

Pahlavan et al. further describe a handoff that occurs between any two of the three technologies as an "intertech handoff." <u>See e.g.</u> Pahlavan et al., Figure 1 on p. 35. A type of "intertech handoff" is precisely what the instant application is concerned with, namely a handoff that occurs as between a cellular wireless technology and a WLAN technology. Utilizing this definition of WLAN technology, Xu et al. cannot be seen to anticipate the instant application.

Should the Examiner still remain unconvinced that the correct definition of WLAN to apply to Xu et al. is the one put forth by the Specification of the instant application, in a further alternative the Applicants contend that a publication of May 2002 supports the notion that CDMA2000 is

not a WLAN technology. Submitted herewith, for the convenience of the Examiner, is a Nortel Networks paper: Nortel Networks, "Delivering Wireless Broadband Services to Regional and Rural Australia," May 2002. In Section 5 on pages 9-13, Nortel Networks review different wireless broadband technologies before ultimately proposing that the CDMA2000 standard be adopted and employed to provide wireless broadband service to Australia. The wireless technologies reviewed include: satellite (Section 5.1), multi-point microwave–or multi-channel, multi-point–distribution service (MMDS) (Section 5.2), local multipoint distribution service (LMDS), wireless local area networks (wireless LANs, i.e. WLANs) (Section 5.4), and cellular networks (Section 5.5).

As an initial observation, the Applicants wish to note that Nortel Networks clearly separates wireless LAN networks and cellular networks into two distinct categories. Second, in reviewing cellular networks, Nortel Networks clearly place CDMA2000 in the cellular networks category. Thus, CDMA2000 does **not** belong in the WLAN technology category. In Appendix A of the paper, the effective coverage of a WLAN network is compared to a CDMA network. The results clearly indicate that the range of a CDMA network is significantly larger than that of an equally-spaced conventional WLAN network. On page 26, Nortel Networks observes that in order to utilize an outdoor WLAN network instead of a CDMA cellular network "the distance between access points [would] need to be reduced by at least half when compared to traditional cellular networks and directional antennas [would] need to be installed at each customer premise." Clearly a WLAN network features different attributes and capabilities than a CDMA2000 network. Based on this definition of a WLAN network, Xu et al. cannot be found to anticipate the instant application.

Turning now to the claims at issue, claim 1 recites:

> A method to perform a low latency inter-technology handoff of a mobile node (MN) **from a wireless local area network (WLAN) to a cellular network,** comprising: transmitting a message from the MN to the WLAN for use by the cellular network, the message comprising information for use in establishing at least one access bearer with the cellular network for an ongoing packet data

> session of the MN being conducted through the WLAN; and responding to the receipt of the message with a Router Advertisement message that is forwarded towards the MN. (emphasis added)

and claim 27 recites:

> A data communications system comprising a mobile node (MN), a wireless local area network (WLAN) and a cellular network, further comprising: a transmitter **for transmitting a message from the MN to the cellular network via the WLAN**, the message comprising information for use in establishing access bearers in the cellular network for an ongoing packet data session of the MN being conducted through the WLAN; and a unit to respond to the receipt of the message with a Router Advertisement message that is forwarded towards the MN. (emphasis added)

Based on the above explanations and arguments, it is clear that Xu et al. cannot be seen to anticipate claims 1 and 27 at least for the reason that there is no express disclosure (or any suggestion of) at least "[a] method to perform a low latency inter-technology handoff of a mobile node (MN) **from a wireless local area network (WLAN) to a cellular network**" (emphasis added) nor "[a] data communications system... comprising: a transmitter **for transmitting a message from the MN to the cellular network via the WLAN**, the message comprising information for use in establishing access bearers in the cellular network for an ongoing packet data session of the MN being conducted through the WLAN" (emphasis added) as claimed in claims 1 and 27, respectively. Applicants respectfully request that the Examiner reconsider and remove the rejections of claims 1 and 27 for this reason.

The Examiner rejected claims 1-6, 23, 26-28, 31-34, 37-40, and 42-43 under 35 U.S.C. 102(e) as being anticipated by Purnadi et al. (U.S. Patent No. 6,708,031). This rejection is respectfully disagreed with, and is traversed below.

The Purnadi et al. rejections the Examiner makes are based on the same incorrect interpretation of CDMA2000 as a WLAN technology. The Applicants repeat and reassert the arguments made above with regards to this misinterpretation. The portions of Purnadi et al. cited by the Examiner

in support of the Examiner's assertion that Purnadi et al. disclose the elements of claim 1 of the instant application are unclear at best. The Examiner cites Fig. 1 of Purnadi et al. as allegedly disclosing "a wireless local area network (cdma2000)." Final Office Action at page 4. As per previous arguments, CDMA2000 is **not** a WLAN technology and should not be considered as such. Hence, Purnadi et al. fail to disclose or suggest a WLAN, let alone "[a] method to perform a low latency inter-technology handoff of a mobile node (MN) from a wireless local area network (WLAN) to a cellular network" as claimed in claim 1 of the instant application. Purnadi et al. also fail to disclose or suggest "[a] data communications system comprising a mobile node (MN), a wireless local area network (WLAN) and a cellular network" as claimed in claim 27 of the instant application. The Examiner's arguments regarding the alleged application of Purnadi et al. to independent claims 33, 38 and 43 of the instant application mirror the Examiner's arguments concerning independent claims 1 and 27. Hence, the Applicants reallege and reassert their arguments concerning claims 1 and 27 as with regards to the alleged application of Purnadi et al. to independent claims 33, 38 and 43. It is clear that Purnadi et al. cannot be seen to anticipate claims 1-6, 23, 26-28, 31-34, 37-40, and 42-43. Applicants respectfully request that the Examiner reconsider and remove the rejections of claims 1-6, 23, 26-28, 31-34, 37-40, and 42-43 for this reason.

The Examiner rejected claims 7-22, 24-25, 29-30, 35-36, and 41 under 35 U.S.C. 103(a) as being unpatentable over Purnadi et al. in view of Malki et al. ("Low Latency Handoff in Mobile IPv4," Internet Draft, pages 1-65, May 2001). This rejection is respectfully disagreed with, and is traversed. Applicants reassert the arguments made above with regards to the application of Purnadi et al. to the subject application. Because Purnadi et al. does not teach "[a] method to perform a low latency inter-technology handoff of a mobile node (MN) from a wireless local area network (WLAN) to a cellular network" as claimed in claim 1 of the instant application nor "[a] data communications system comprising a mobile node (MN), a wireless local area network (WLAN) and a cellular network" as claimed in claim 27 of the instant application, and Malki et al. does not teach "[a] method to perform a low latency inter-technology handoff of a mobile node (MN) from a wireless local area network (WLAN) to a cellular network" as claimed in claim 1 of the instant application nor "[a] data communications system comprising a mobile node

(MN), a wireless local area network (WLAN) and a cellular network" as claimed in claim 27 of the instant application (and the Examiner does not assert that Malki et al. does teach either of these), then the proposed combination does not teach "[a] method to perform a low latency inter-technology handoff of a mobile node (MN) from a wireless local area network (WLAN) to a cellular network" as claimed in claim 1 of the instant application nor "[a] data communications system comprising a mobile node (MN), a wireless local area network (WLAN) and a cellular network" as claimed in claim 27 of the instant application. In that Purnadi et al. is inapplicable, claims 7-22, 24-25, 29-30, 35-36, and 41 cannot be seen as unpatentable over Purnadi et al. in view of Malki et al.

The Examiner is respectfully requested to reconsider and remove the rejections of claims 1 and 27 under 35 U.S.C. 102(b) as being anticipated by Xu et al., claims 1-6, 23, 26-28, 31-34, 37-40, and 42-43 under 35 U.S.C. 103(e) as being anticipated by Purnadi et al., and claims 7-22, 24-25, 29-30, 35-36, and 41 under 35 U.S.C. 103(a) as being unpatentable over Purnadi et al. in view of Malki et al., and to allow all of the pending claims 1-43 as now presented for examination. An early notification of the allowability of claims 1-43 is earnestly solicited.

Respectfully submitted:

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3 October, 2002

Steve Wood
President
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Mr. Dick Estens (Chair)
Regional Telecommunications Inquiry (Submissions)
Locked Bag 8690
Canberra City, ACT 2600

Dear Mr. Estens,

I apologise for the lateness of this submission but I believe the issues that it raises are fundamental to the Regional Telecommunications Inquiry's third and sixth terms of reference (internet access and sharing in future telecommunications benefits).

Attached is a submission made by Nortel Networks earlier this year to the House of Representatives Inquiry into Broadband Wireless Technologies. This is very pertinent to your Inquiry's considerations because it points out that CDMA 2000 provides the only realistic and economic means of providing rural and regional Australia with 3G mobile data and voice services. These services will become essential in future years as business increasingly comes to rely on them to efficiently conduct their activities and consumers make use of the many services envisaged.

CDMA 2000 also can be used to provide fixed data access at speeds in excess of 60 kbps, although how this is tariffed is obviously a matter for the providing carrier.

Since the submission was made, the deployment of CDMA 2000 has continued to grow into more countries and the number of users has now grown to over 17 million. Also, the next evolution of CDMA 2000, CDMA 2000 Ev-DO which will provide far higher data speeds, is undergoing initial deployments and successful trials in Asia and North America.

Within a couple of years, a 3G mobile data capability will be considered as important to communities as are current 2G mobile services.

I would welcome the opportunity to explore with you the capabilities of CDMA 2000 and organise a demonstration at our Wollongong Technology Centre. To arrange this please contact Graeme King on (02) 6279 7710 or at graemek@nortelnetworks.com.

Yours sincerely,

Steve Wood

NORTEL NETWORKS

Delivering Wireless Broadband Services to Regional and Rural Australia

May 2002

NORTEL NETWORKS

1 Executive Summary

- Broadband is an informal term used to indicate a high-speed data offering. It generally implies a digital service delivering data rates in excess of 64kbps but can be in the order of several megabits per second.
- Providing broadband to the 'last mile' in Rural Australia may in reality be distances greater than 50km.
- The rural and remote population in Australia is relatively small but is distributed over vast areas. Nortel Networks believe that the ability to leverage of existing infrastructure to provide a range of wireless broadband services, both fixed and mobility is key to achieving maximum social and economic benefits. Upgrading the CDMA network to the 3G CDMA2000 standard provides a mechanism to economically cover these vast areas.
- CDMA2000 technology leverages the existing installed CDMA network infrastructure to provide a sustainable platform that can deliver both fixed and mobile, wireless broadband services that can meet today and tomorrows requirements. The use of a carrier grade network and licensed spectrum to deliver these services ensures sustainability. Sustainability is an important consideration as infrastructure must be maintained and upgraded in the future if it is going to usefully provide high-speed data services.
- Other wireless technologies are available and each may have a unique application in delivering wireless broadband services to rural consumers. However Nortel Networks believe that CDMA2000 is the only technology that can economically provide the vast umbrella coverage required to service the majority of the rural broadband requirements in the Australian context.
- CDMA2000 benefits from the global economies of scale ensuring considerable economic benefits from both an infrastructure and terminal perspective.

- The 3G CDMA2000 standards provides a long term evolution through 1xEV-DO and 1xEV-DV that continues to leverage off the CDMA infrastructure and can deliver peak data rates of 2.4Mbps and aggregate throughputs of 11.7Mbps per base station.

2 Purpose and Scope

This paper, written by Nortel Networks Australia, responds to the terms of reference for the House of Representative Standing Committee on Communications, Information Technology and the Arts inquiry into the current and potential use of wireless technologies to provide broadband communications in Australia. The paper explores the role and unique ability of CDMA 2000, 1xRTT and its evolution as the wireless broadband technology to provide a 'last mile' fixed and mobile broadband solution, particularly in rural and regional areas.

The scope of this paper is to:

1) Provide a definition for broadband and its applicability in both the Australian and Global contexts.
2) A review of the different wireless broadband technologies that are available which briefly identifies the benefits and limitations of each technology.
3) A detailed analysis of why Nortel Networks believe that the 3G standard CDMA2000 1xRTT provides the unique opportunity to economically deliver broadband services to the greatest number of rural and regional customers in Australia.

3 Introduction

Established more than a century ago, Nortel Networks has participated in major developments in the evolution of communications networks technology worldwide.

Our employees are currently delivering networking and communications services and

infrastructure for customers in more than 150 countries, including established carriers, new network operators, leading wireless service providers and enterprises. Our Australian customers include carriers such as Optus, PowerTel, Primus and Telstra and our corporate customers include the Australian Stock Exchange, Qantas and the Department of Defence.

We spent US$3.2 billion in 2001 on industry-leading R&D, carried out by approximately 17,400 engineers, designers, scientists and other R&D employees at 31 sites around the world.

Leading change has always been Nortel Networks competitive strength. We have transformed and reinvented ourselves countless times, changing from a pioneering telephone manufacturer supplying primarily the Canadian market to one of the world's largest global providers of high-performance, intelligent, value-added Internet and advanced "carrier grade" data networks that provide the quality, scalability and reliability to serve as a new foundation for global communications.

Our commitment to being the leader in next-generation network evolution is challenging and futuristic, but grounded in the reality that we currently have one of the best portfolios of products and technologies in the industry. We have three core business areas: Metro and Enterprise Networks, Wireless Networks and Optical Long-Haul Networks.

Nortel Networks is in a unique position to understand broadband issues from the perspectives of both supply (service provider) and demand (consumer/enterprise). Our portfolio and relationships extend to both, globally, and our knowledge of both helps us determine how end-users' requirements can best be met through technology in a service provider network.

Nortel Networks learns how to innovate from direct enterprise, government, and academic experience. Enterprise customers are typically the first adopters of new

capabilities, which are soon offered by public networks. By applying lessons learnt in the enterprises to the service provider networks, consumers and small to medium-sized enterprises can use advanced communications capabilities to their own advantage.

4 Broadband: The Global and Australian Context

Broadband is an informal term used to indicate a high-speed data offering. It generally implies a digital service delivering data rate in excess of 64kbps but can be in the order of several megabits per second. Broadband is an ongoing evolution with broadband requirements expected to grow in the future to meet consumer and business expectations. It encompasses both fixed and mobile capabilities, "always-on" and is more about the technical capability to meet a consumer's or business' needs than just high-speed web browsing.

The 'last mile' is a term often associated with broadband and refers to providing a high-speed connection from the backbone core networks, into the homes and businesses of the end users. With reference to rural and remote Australia the 'last mile' may be distances far greater than 50km. This should be kept in mind when evaluating suitable technologies to provide this connectivity.

As discussions and debate on broadband have progressed, a global consensus has emerged on some factors that are key to deploying the first-generation of this technology. Without question, all interested players have great expectations for universal broadband, wired and wireless. All agree that broadband—in the sense of faster and better access to the Internet—is important and that opening up the last-mile connection to homes and to small-to-medium-sized businesses is the most pressing issue in unclogging network communications worldwide.

Broadband deployment will expand markets and enable new business models. It will drive new investment in fields such as computer applications, entertainment, and online services. It will enable advanced health-related services, telecommuting, new ways for businesses to work virtually with suppliers, partners, and customers, and new forms of online entertainment and educational products. It will create an environment where new services can bloom.

The global consensus recognizes that there are several ways to make much more bandwidth available. Various technologies fulfill the technical requirements for bridging the "last-mile" gap between high-capacity networks and their users, both individuals and organizations. Each technology - fibre, cable, DSL, broadband wireless, and satellite provides unique capabilities. Each has its advantages and disadvantages. These technologies compete with each other, appealing to users on the basis of performance, price, quality of service, geographical coverage, user friendliness, customer service and customer satisfaction.

Broadband can provide fast, easy and ubiquitous access to information and communication in many forms including Internet access, email and access to business-based data such as corporate LAN. Broadband data services are not limited to the fixed user but may also be required and provided to mobile users. The actual delivery mechanism can be based on wired or wireless based technologies and many different factors must be considered in tailoring a service to the unique needs of Australians, particularly those living in rural and remote areas.

Broadband networks have to be reliable (available when you need it), secure (information for intended audiences only, systems secure from hackers), evolvable (leveraging invested assets when implementing the next-generation solutions), scalable (the network can grow cost-effectively without performance degradation), manageable (network performance, service delivery, and user parameters can be managed), and multi-service (service agnostic from email through to multimedia). These attributes are necessary for content providers and end users to trust the network enough to adopt broadband for critical business and personal use. They're necessary so service providers can deliver value customers are willing to pay for and to engender mainstream use.

The bulk of the Australian population lives in large cities and towns where a variety of broadband delivery mechanisms are or could be made available. The density of the potential user population means that a service provider can expect to achieve an acceptable return of investment for installed infrastructure and on-going operational costs. Thus, viable business cases can be developed for a variety of different broadband technologies.

While Australia's rural and remote population is relatively small in number, it is distributed over vast areas. Coupled with sometimes challenging terrain and hostile natural environments, this vast area restricts the use of wired-based technologies, particularly for the "last mile" to the customer premises, and predisposes the solution to one that is radio based. The ability to leverage existing infrastructure and provide a range of services will be a key factor in selecting an appropriate technology that has a viable business case for the service provider and thus a cost effective and long-lived service for users. Sustainability is an important consideration because the infrastructure must be maintained and upgraded in the future if it going to usefully provide services. There is a risk that short-term "fixes" will not be maintained, leaving users without services. Sustainability is enhanced when the broadband backbone connection is used for a range of platforms.

5 Wireless Broadband Alternatives

The growth of fixed and mobile wireless subscribers worldwide has surpassed all expectations. Given it's ubiquity, flexibility, and ability to be deployed quickly, wireless is already the primary form of communications in many countries.

The technologies reviewed in this section do not constitute an exhaustive analysis of each broadband technology but rather highlight the more commonly recognised attributes and limitations. Nortel believe that a combination of these technologies can be deployed in a complementary fashion to provide fast, reliable access to broadband services in areas not served with fixed broadband infrastructure or to provide capabilities such as mobility that fixed infrastructure cannot provide.

Multiple bands of wireless spectrum can be used to provide high-speed broadband access, with licenses allocated to companies delivering cellular, satellite, MMDS, and LMDS, and technologies.

5.1 Satellite

Two-way high-speed Internet access via satellite is being offered as a niche service to remote communities that have no access to other broadband technologies. Data rates range from 64 to 400 kilobits per second. Two-way satellite services are expensive to offer by network operators and high customer premise equipment costs make this a niche application for very remote users.

A more cost effective solution for remote users is a one-way satellite service which can offer high speed downloads through the satellite link but require a dial-up uplink. This solution does not offer always on connectivity.

5.2 MMDS

Multi-point microwave—or multi-channel, multi-point—distribution service (MMDS) is a broadband wireless (line-of-sight) point-to-multipoint communication system located in the 2.1 GHz to 2.7 GHz bands. MMDS has been used around the world for more than 30 years to provide a one-way, *analog* wireless broadcast service. As such, the MMDS industry has been widely known as the wireless cable industry.

With the advent of the Internet and the use of digital technology, MMDS is now seen as a possible broadband-service-delivery option. MMDS providers, primarily in the U.S, are upgrading their networks to create interactive Internet-access capability, addressing residential demands for broadband digital data and TV. MMDS represents a very small portion of Internet access today and is limited by line-of-sight radio design issues such as terrain and rainfall.

5.3 LMDS

Local multipoint distribution service (LMDS) is another broadband wireless (line-of-sight) point-to-multipoint communication system. It operates above the 20 GHz band reducing the coverage (range) that can be achieved from each access node because it is limited by line-of-sight radio design issues such as terrain and rainfall. It is a digital system by design and can be used to provide two-way voice, data, Internet, and video services. Operators in the LMDS band mainly target businesses in metro areas and it has found a market in providing broadband services to building distribution systems rather than individual customers.

Many telecom vendors have developed a full portfolio for the LMDS band and are actively marketing the equipment to service providers. Lack of equipment standards has been a problem, in terms of ensuring interoperability and keeping costs down, affecting LMDS' market success. As with MMDS, LMDS represents a very small portion of Internet access today.

Both MMDS and LMDS are solid alternative technologies to DSL and cable where access to those technologies may be restricted.

5.4 Wireless Local Area Networks (LANs)

There is growing interest in wireless LAN technologies, such as Bluetooth or 802.11B, for short-range high-speed access in public places such as airport lounges and coffee shops. In early 2001, Starbucks announced its intention to deploy 11-megabit per second wireless LANs in all 3,000 of its U.S. retail outlets. Many CIO's have expressed interest in wireless LAN technology, which could also have a future in home networking.

Although wireless LAN offers high data rates, it has a coverage link budget that is approximately 30-40dB worse than 3G cellular technologies limiting its application to isolated hot spots and in-building systems. Otherwise, useful ranges can be achieved by using directional antennas in a line-of-sight point-to-point mode when other systems and users are not adversely affected. Hence, it in these circumstances it may have a role as a consumer grade point-to-point service option.

Conventional wireless LAN works extremely well for in-building applications where it is possible to control and isolate interference from other sources. Appendix A details a study performed by Nortel Networks which compares the results of a 3G cellular deployment versus a macro cell Wireless LAN solution.

Wireless LAN utilises unlicensed spectrum, which introduces reliability and scalability problems for deployment over wide areas. Ensuring a carrier grade network that continues to provide good quality of service would be a major issue due to uncontrolled co-channel interference arising from competing wireless LAN deployments and other technologies that utilize this spectrum.

5.5 Cellular Networks

The first generation of mobile networks deployed were analogue systems such as AMPS. Over time, second-generation mobile networks have replaced AMPS networks due to a lack of capacity and services that could be offered.

The evolution of networks to the second-generation wireless technologies of GSM, TDMA, and CDMA led to a significant reduction in network costs and an improvement in radio frequency sensitivity, enabling cell phones with a more manageable battery size and longer battery life. This improvement in mobile phone service, along with the reduced costs that enabled price competition, changed the business model and broadened the market.

The next network transformation for wireless involves the 3G technologies of CDMA2000 and UMTS, which will also mean significant, network cost reductions. These networks will have increased utility, as they will be the platforms for "always-on" high-speed mobile-data applications. Innovation is also occurring in the core of the network as circuit switching evolves to enable the end-to-end packet networks required for 3G.

3G promises data rates in the range of 60 kbps to 2.4Mbps, which will enable broadband wireless applications such as those that the Japanese carrier - NTT DoCoMo is offering. Video pictures can be downloaded in 2.1 seconds versus 23 minutes with 2G technologies. Web pages can be downloaded in less than a second versus 30 seconds with 2G technologies.

Currently the two second-generation technologies that are available in Australia are CDMA and GSM. Looking at the third-generation (3G) evolution of these technologies CDMA will evolve down the CDMA2000 path, initially with 1xRTT then 1xEV-DO and DV and GSM will evolve to GPRS and then UMTS. These two competing 3G cellular technologies will continue to benefit from the global economies of scale that have driven substantial cost reduction in the delivery of mobile networks throughout the world, both from an infrastructure and terminal equipment perspective.

Throughout the world cellular voice services have cannibalized local wired voice services. 3G cellular will affect fixed broadband technologies in a similar way.

6 The CDMA2000 Value Proposition

There are many different factors that need to be addressed when looking at the most appropriate access technologies for delivering broadband content to regional and rural subscribers throughout Australia. In general there are high costs associated with broadband infrastructure for both the carriers deploying it and the companies creating the technology. To achieve the maximum social and economic benefits of broadband deployment the technology must be cost effective for the consumer and still provide the opportunity for the service provider to make a reasonable return on their investment.

In rural Australia, the population is widely dispersed and the investment to enable 3G wireless broadband access will be cost prohibitive unless existing network infrastructure can be leveraged and the infrastructure used to provide a variety of services. The upgrade of the CDMA network to the 3G standard CDMA2000 1xRTT is relatively inexpensive as it utilizes the entire existing infrastructure that is in place today. By adding additional hardware and software, 3G broadband access could be cost-effectively offered over the entire coverage area of the CDMA network today.

Based on the recent CDMA2000 network deployments in the US, the CDMA Development Group (CDG) believe that operators are upgrading existing CDMA

networks to CDMA2000 1xRTT for an estimated $3US per population covered. Locally Nortel Networks estimates a similar price per covered population to upgrade the Australian network

6.1 Breadth of Coverage

The existing Telstra CDMA network is geographically the largest mobile network in Australia, covering approximately 97% of the population and 13% of the country's land mass. This equates to over 1.1 million square kilometers. This is expected to be extended to cover an estimated 1.4 million square kilometers by the end of 2002, which is approaching three times the geographical coverage of any of the GSM network in Australia.

A CDMA 1xRTT Base Station can offer far greater coverage than any other mobile technology widely deployed throughout the world. This is primarily due to two factors.

1) Since CDMA2000 technology operates at 800MHz compared to UMTS at 2.1GHz, far greater coverage can be achieved from a single Base Station due to the lower attenuation of RF signals operating at lower frequencies. The result of this is that some existing CDMA base stations provide coverage up to 130kms over land.

2) UMTS, GPRS and GSM all have timing limitations that usually don't allow communication with a base station at distances beyond a 35Km radius. In contrast 1xRTT will enable devices to communicate at distances up to 200km from the base station provided there is enough signal strength.

Both of these factors will prevent widespread deployment of UMTS networks throughout regional and rural parts of Australia making 1xRTT the only viable solution for a 3G network in these areas.

In metropolitan regions there is an abundance of fixed broadband technologies available. Services delivered on the 1xRTT network in these areas would be primarily focused on mobility applications. These same mobility applications can also be offered to regional and rural customers via 1xRTT. In addition, 1xRTT fixed wireless terminals are available to enable "always on" connectivity with peak data rates up to 153.6kbps on both the uplink and downlink to regional and rural data users. With the addition of high gain or directional antennas installed at the customer premise for locations near to the cell edge, reliable fixed data services could be offered over the entire coverage area of the existing voice mobility network.

1xRTT networks are backwards compatible with existing CDMA handsets. This means that users can continue to make voice calls with their existing handsets without the need to change to 1xRTT handset unless they wish to make use of the greater data service capability.

It should be emphasized that 1xRTT provides a multi-service platform with multiple revenue sources to sustainably fund the mobile network and backhaul infrastructure. These services include mobile voice and data, and fixed voice and data.

6.2 Capacity and Throughput

In Australia, the 800MHz band spectrum allocation of 10 MHz to a licensee enables six 1.25Mhz carriers for the CDMA network. Currently, most of this spectrum is not utilised which ensures that there is significant capacity for a high-speed packet data service using 1xRTT.

Today the peak data rate that can be offered to a single user with 1xRTT is 153.6kbps. In Release A of the 1xRTT standard this will increase to 307kbps. Nortel has modeled different applications to better understand how many users can be supported by a single 1xRTT base station for each application type. Table 6.1 and 6.2 represent the finding for web browsing and email with attachments respectively. Assuming a typical rural cell site

radius of 40km this capacity can be distributed over 5000 square kilometers from a single base station.

Type of Application	Bytes/Web Page	No. of Web Pages downloaded in BH per user	No. of Supported users per base station
Web Browsing	48KBytes	5	6480

Table 6.1: Number of web browsing users supported per base station

Type of Application	Bytes/Email	No. of emails downloaded in Busy Hour per user	No. of Supported users per base station
Email (with attachments enabled)	30KBytes	2	26100

Table 6.2: Number of emails users with attachments supported per base station

6.3 Reliability and Scalability

The CDMA 800MHz band is licensed spectrum, preventing ad hoc network deployments by multiple operators that may cause widespread interference, ultimately affecting the coverage, reliability and quality of the service. With unlicensed spectrum a wireless broadband service could be offered to consumers in a certain location but at any time unacceptable service interruption may arise if additional transmitters or sources of interference are deployed within the service area. It is Nortel Networks experience that these interruptions are unacceptable to business and commercial users and may affect the long-term success of broadband adoption in such areas

6.4 Global Benefits and Economies of Scale

By the middle of 2002, 1xRTT networks will be commercially deployed throughout Korea, Japan, Canada, Latin America, USA and New Zealand. Other countries planning to deploy 1xRTT networks towards the end of 2002 are China, India, Israel, and Thailand. As of May 2002 there are over 90 different 1xRTT terminal devices are available on the market. Figure 6.1 shows the relative pricing for 3G cellular handsets and the cost erosion that will be experienced as the terminals are deployed around the

world. Nortel Networks believes that this mass volume production of terminals will make widespread adoption of wireless broadband possible.

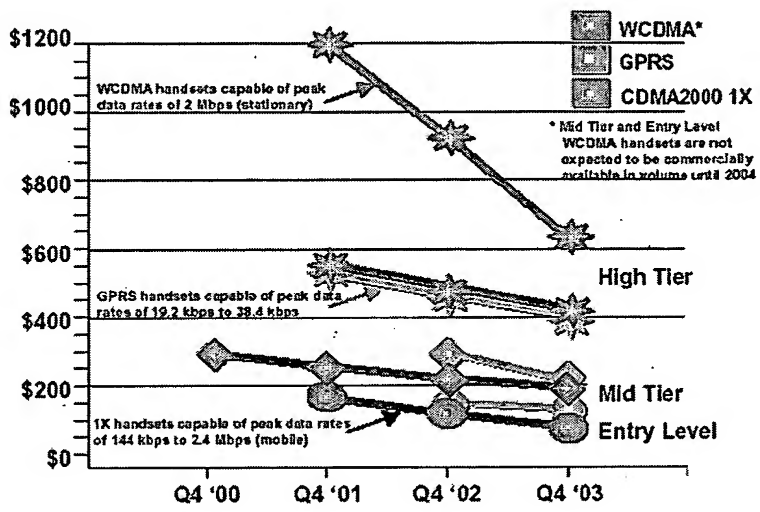

Figure 6.1: CDMA2000 1xRTT device pricing ($US)

Global experience has shown that the upgrade of traditional CDMA networks to 1xRTT is a relatively simple process. Based on other deployments that have occurred it is estimated that the upgrade and optimization of the entire Australian CDMA network to 1xRTT capability could be done within a six-month period. This would enable rapid delivery of high-speed packet data services to rural users.

6.5 The CDMA2000 Evolution

1xRTT is the first step in the CDMA2000 Evolution (figure 6.2). The CDMA2000 evolution provides 3 times the data capacity of 1xRTT over a single 1.25MHz carrier, via 1xEV-DO (Data Only) and 1xEV-DV (Data and Voice). Similar to 1xRTT, 1xEV-DO and DV utilizes the same spectrum as the existing CDMA network and again leverages off the installed CDMA Base Station infrastructure and core network.

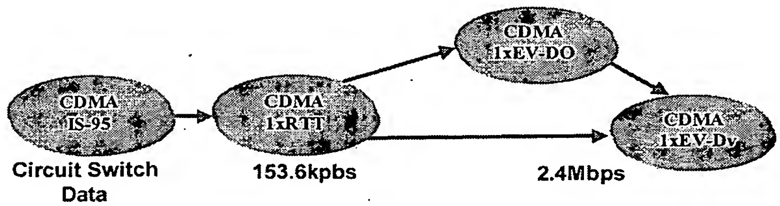

Figure 6.2: The CDMA2000 Evolution

The CDMA2000 evolution provides much greater data rates beyond 1xRTT with 1xEV-DO (Data Only) and 1xEV-DV (Data and Voice). Similar to 1xRTT 1xEV-DO and DV utilizes the same spectrum as the existing CDMA network and again leverages off the installed CDMA Base Station infrastructure and core network.

6.5.1 1xEV-DO

1xEV-DO is a data only standard that offers higher bandwidth to users when compared to 1xRTT. It requires a dedicated 1.25Mhz carrier with peak data rates and average data throughput per user of 2.4 Mbps and 650 kbps respectively. With equivalent coverage to 1xRTT, 1xEV-DO truly provides a cost effective broadband alternative for rural and regional subscribers with similar performance to ADSL and Satellite services that are currently offered today. In addition to offering a dedicated data service, hybrid 1xEV-DO/1xRTT terminals will be available to offer a mix of data and voice services. 1xEV-DO is much better adapted to provide the highest possible data throughputs, reliability of service and user experience. 1xEV-DO is ideally suited areas where the need for dedicated wireless data bandwidth exists.

From an industry timing perspective, 1xEV-DO is expected to be commercially available at the beginning of 2003. Trial networks are being deployed in the USA towards the second half of 2002.

6.5.2 *1xEV-DV*

1xEV-DV is an integrated data and voice standard. It is expected to be ratified by the ITU this month and is similar to 1xEV-DO, but with some QoS improvements supporting real time services such as streaming audio/video. In voice mode, 1xEV-DV delivers equivalent voice capacity as 1xRTT voice. In addition, 1xEV-DV would support both voice calls and data sessions simultaneously. With the ability to flexibly accommodate the varying voice/data traffic mixes on a dynamic basis, 1xEV-DV offers operators the ability to use one carrier to address what would potentially require two carriers (one voice, one data). 1xEV-DV can be deployed in almost any scenario given its flexibility. It can serve as a data only carrier when added to an 1xRTT network or as a voice only carrier if an operator is deploying equipment in a new coverage area where the data component is not well understood and, more commonly, in any general deployment where both high-speed data and voice services are expected. The real benefit of 1xEV-DV becomes apparent in areas where there might be a varying mix of voice and data traffic at different times of the day. 1xEV-DV is expected to be available at the beginning of 2004.

1xEV-DV is backwards compatible with 1xRTT, 1xEV-DO and CDMA allowing a graceful evolution that allows consumer to use existing terminal for services provided by earlier versions of the CDMA 2000 family.

Since 1xEV-DV is an evolution of the CDMA2000 standard it will be fully backward compatible with 1xRTT terminals. Additionally 1xEV-DV will also support interoperability with 1xRTT networks allowing 1xEV-DV terminals to downgrade the service to 1xRTT in areas where 1xEV-DV coverage is not available.

7 Conclusion

The 3G standard CDMA2000 provides a unique opportunity to deliver wireless broad services to the majority of Australia's rural and regional consumers. The benefits can be summarised as the following:

- Cost effective due to the large installed CDMA infrastructure.
- CDMA2000 1xRTT is available now can be deployed in a short timeframe.
- The CDMA2000 technology provides a multi-service platform with multiple revenue sources to sustainably fund the network investment. These services include both mobile voice and high-speed packet data, and fixed voice and high-speed packet data.
- The current CDMA network is geographically the largest network in Australia and provides coverage to over 97% of the population.
- CDMA2000 technology benefits from the global economies of scale, ensuring cost effective customer premise equipment.
- CDMA2000 provides a future proof evolution that continues to leverage of previous infrastructure investments through 1xEV-DO and 1xEV-DV. These technologies can provide peak data rates up to 2.4Mbps.
- CDMA2000 is carrier grade network that can be scaled to meet future demand. It utilises licensed 800MHz spectrum so that continued quality of service can be delivered to the end user.

Other broadband wireless offerings may have a role in particular circumstances that take advantage of their attributes and cost structure, however, careful consideration should be given to their sustainability and ability to be maintained and upgraded in the future.

8 Appendix A

This document in its current form is a notebook capturing an analysis to compare outdoor WLAN performance with cellular networks. Link margin analysis shows 2.4GHz 802.11b WLAN has a >30dB margin deficit to cellular, initially suggesting outdoor WLAN would not be viable.

Simulations show that WLAN can provide viable fortuitous service at substantial distances from the access point (AP) if interference is controlled by installing directional antennas at all user locations. At between ¼ and ½ of the cell spacing of a CDMA suburban cellular network. WLAN access points may provide a viable contiguous coverage footprint with no external interference. The financial viability would depend on a very cost effective backhaul solution or more innovative techniques such as ad hoc routing of packets between access points with fixed backhaul provided to only a subset of access points. The analysis of an ad hoc solution is beyond the scope of this study.

8.1 Link Margin Comparison

	EDGE	GPRS	IS95	1xRTT	1xEV	UMTS
Reverse System Margin						
System Noise B/W(mhz)	0.270	0.270	1.228	1.228	1.228	3.840
Noise Floor (=KTB) (dBm)	-119.7	-119.7	-113.1	-113.1	-113.1	-108.2
RX Noise Figure(dB)	3.3	3.3	3.3	3.3	3.3	3.3
Reverse Eb/No Target (dB)	3.0	3.0	5.0	2.5	2.5	1.0
Demod Spread Gain @ 60KB (dB)	0.0	0.0	13.1	13.1	13.1	18.1
Soft Handoff Gain (dB)	0.0	0.0	4.0	4.0	4.0	4.0
Loading Noise Margin (dB)	3.0	3.0	3.0	3.0	3.0	3.0
=RX Sensitivity (dBm)	-110.4	-110.4	-118.9	-121.4	-121.4	-122.9
Mobile TX Power (dBm)	30.0	30.0	23.0	23.0	23.0	21.0
System Uplink Margin(dB)	**140.4**	**140.4**	**141.9**	**144.4**	**144.4**	**143.9**

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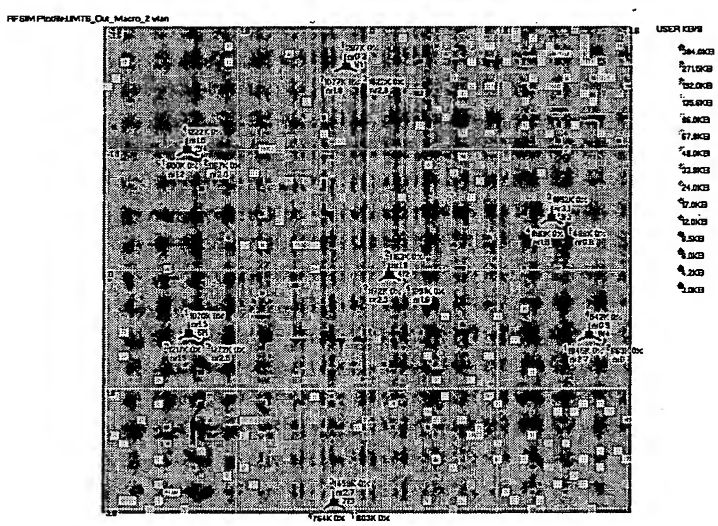
802.11b	1.0	2.0	5.5	11.0
Modulation % Code	BPSK	QPSK	QPSK CCK	QPSK CCK
System ChipRt & Noise B/W(mhz)	11.000	11.000	11.000	11.000
Noise Floor (=KTB) (dBm)	-103.6	-103.6	-103.6	-103.6
RX Noise Figure(dB)	9.0	9.0	9.0	9.0
Required Eb/(Io+Nt) (dB)	14.0	14.0	14.0	14.0
Demod Spreading Gain(dB)	10.4	7.4	3.0	0.0
AP RX Sensitivity(dBm)	**-91.0**	**-88.0**	**-83.6**	**-80.6**
MT TX Power(dBm)	18.0	18.0	18.0	18.0
Time Varying Fade Margin (dB)	5.0	5.0	5.0	5.0
Max System link Margin(dB)	**104.0**	**101.0**	**96.6**	**93.6**

Wireless LAN Link Margin is at least 30dB less than existing cellular standards

8.2 Baseline CDMA Mobility Performance

A cluster of seven 3G CDMA tri sector cell sites are modeled on 25m masts in a suburban environment with mean cell spacing of 2 Km. Most user locations achieve at least 150Kbps throughput.

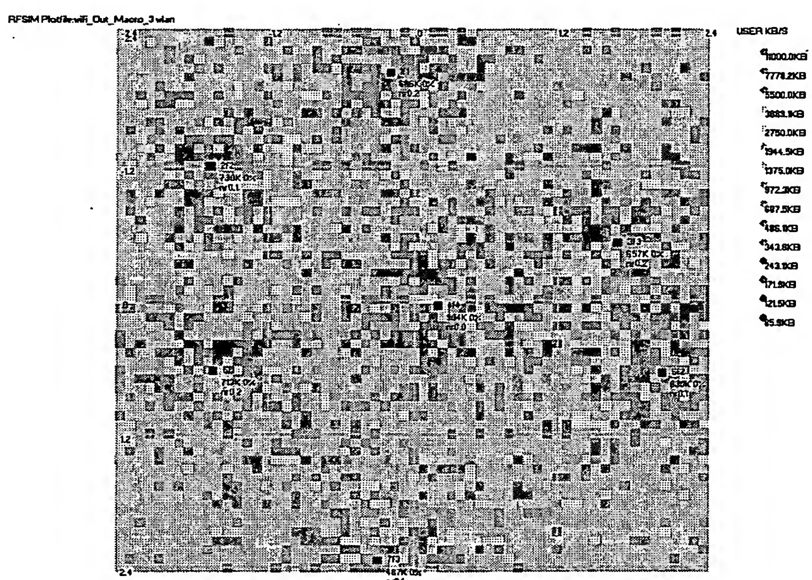


8.3 802.11b Wireless LAN Overlay of WCDMA Network

8.3.1 *WLAN Baseline at 2000M AP Spacing, X4 reuse*

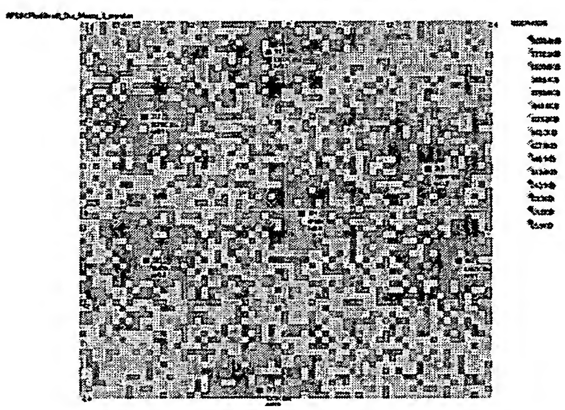
802.11b access points and terminals are substituted for the WCDMA sites and Mobiles with 11dBd high gain omni directional antennas. The resulting plot of peak throughput per user is shown below. Most users further than 200m from the site only achieve fortuitous coverage. The islands of coverage surrounding each site allow the problems of cell edge frequency coordination to be avoided.

Other services in the 2.4G unlicensed band can also be modeled to show further loss of coverage area due to interference.



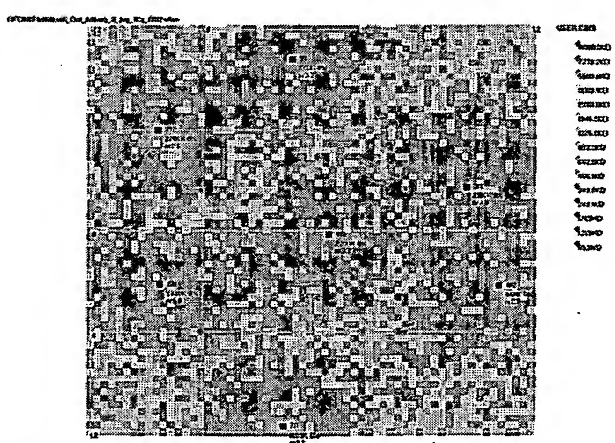
8.3.2 Directional Antenna at WLAN Terminals (2000M)

To improve outdoor WLAN performance, 10dB directional antennae are modeled at each user location aimed at the geographically closest site (not necessarily the best server). Coverage is solid out to a 600m radius, but cell edge performance is still unusable.



8.3.3 Reduced 1000M AP Spacing and tighter (X2) frequency reuse

If the WLAN cell spacing is reduced to 1000m and the frequency reuse is reduced to 2 then the coverage is now contiguous. Cell Edge Interference is managed by using directional antennas at terminals to increase the probability of a single dominant server at each user location.



8.3.4 500M Spacing , Frequency Reuse 2

Cell Edge performance is degraded more by interference than lack of coverage.

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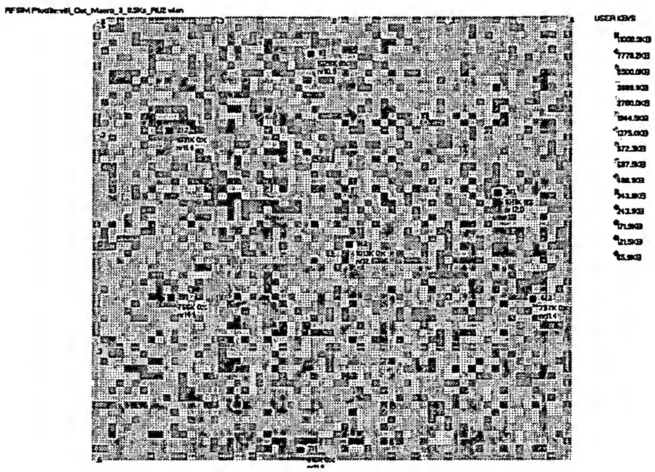
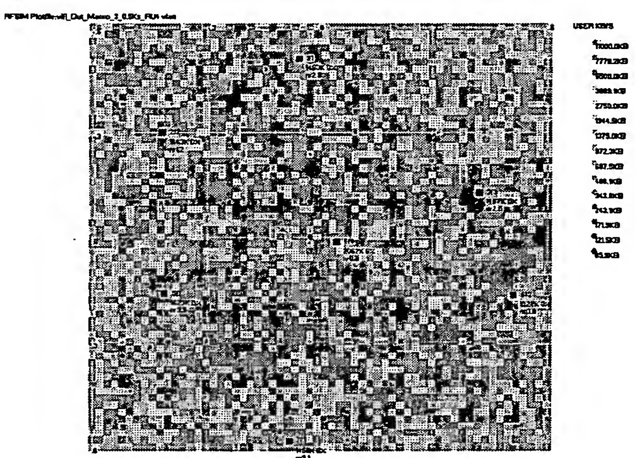


8.3.5 *500M Spacing, Frequency Reuse 4*

If frequency reuse factor is increased from 2 to 4 then the granular coverage is contiguous without requiring directional antennas. Bins with abnormally high clutter loss are still not covered.



8.4 Appendix A Conclusion

Providing continuous coverage for high-speed packet data using CDMA cellular technologies is relatively simple due to the superior link budget that accompanies these technologies. Simulations have shown that outdoor WLAN for broadband access is high risk but possible to deploy if the access point locations and the user directional antennas

are carefully planned. In order to do this the distance between access points will need to be reduced by at least half when compared to traditional cellular networks and directional antennas will need to be installed at each customer premise. This increase in access points does introduce the requirement for a more economical solution to backhaul the data captured by each network node.

Although according to these simulations it is possible to do a macro WLAN network deployment. This architecture does go against the intended purpose of conventional unlicensed WLAN networks and greater issues such as protection from interference, long term network operability and maintainability need to be considered.